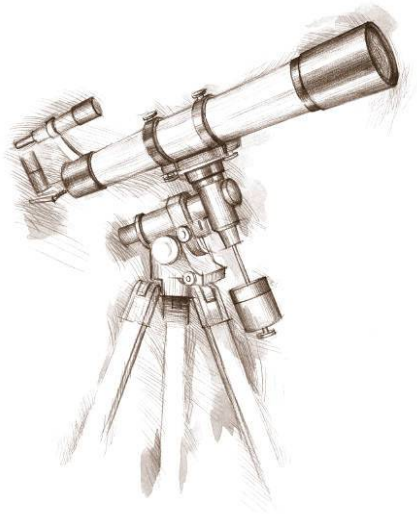
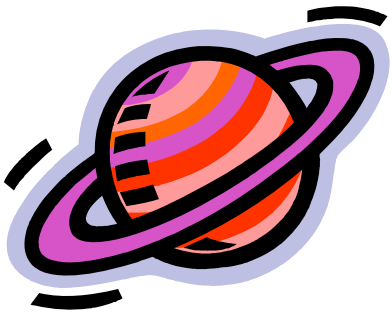
The Education Bureau and Ho Koon Nature Education cum Astronomical Centre



jointly present



Using Computerized Telescope to Facilitate learning and teaching of “Astronomy And Space Science" in the New Senior Secondary Physics Curriculum

A Course for School Laboratory Technicians

Session 2

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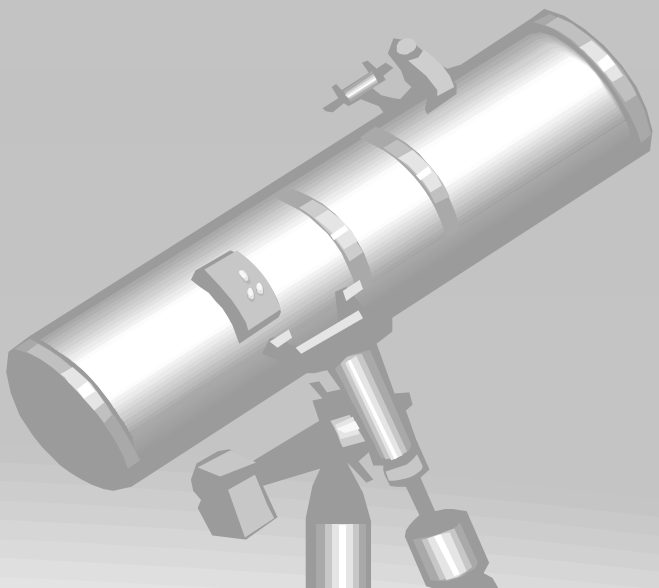


1 Controlling an SGT with a planetarium software

One of the big advantages of a planetarium software is the ability to control a telescope. This ability to point a telescope accurately at any place on the celestial sphere has made observing more enjoyable and less tiresome. A planetarium software does not only give a GoTo telescope an attractive graphical interface but also make newly discovered objects, such as comets, accessible by the telescope. This has made the SGT an unreplaceable tool for astronomical research.

Objectives:

1 Consolidating the manipulation of an SGT;
2 Open up a new way to astronomical research.

A Tools

1 A telescope with tracking system that complies to the Astronomy Common Object Model (ASCOM) standard;
2 A computer with *Windows* OS and Microsoft's *dotNet Framework installed*;
3 The ASCOM platform must also be installed. ASCOM acts as a communication translator between the computer and the telescope;
4 You can get to know more about ASCOM and download the software here: http://ascom-standards.org/;
5 You should install ASCOM drivers specially written for your telescope mount;
6 Planetarium softwares that are compatible with ASCOM are :TheSky v.5/6、Starry Night Pro v.6, Hallo Northern Sky (freeware), Cartes du Ciel (freeware) and Stellarium (freeware);
7 Hallo Northern Sky v.2.3：www.hnsky.org/software.htm
Cartes du Ciel v.2.7：http://www.stargazing.net/astropc/download.html
Cartes du Ciel v.3 beta：http://www.ap-i.net/skychart/en/download
StellariumScope V2010.04.11, a Stellarium 0.10.4 plugin (Windows XP/VISTA/7)
http://www.welshdragoncomputing.ca/index.php?option=com_content&view=category&layout=blog&id=31&Itemid=39
8 If you are not sure which telescopes are ASCOM compatible, try visiting the following web page first: http://ascom-standards.org/Support/Index.htm

B Controlling with the Vixen Star Book／Star Book-S

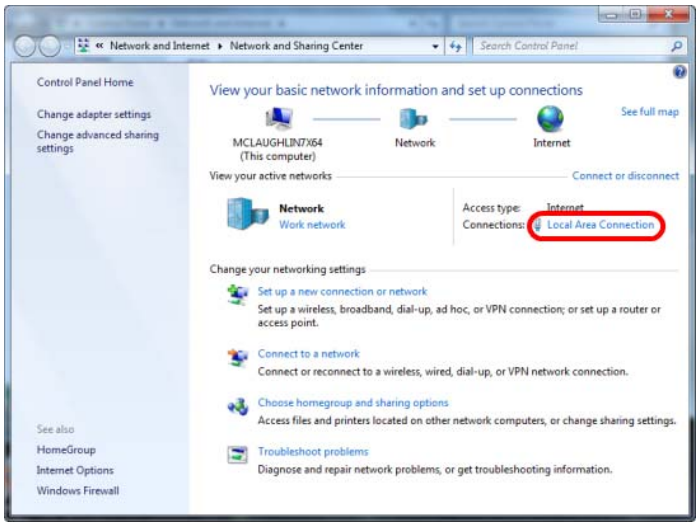
1 Download the latest ASCOM driver for Star Book at http://enzerink.net/peter/astronomy/ and install it;
2 Setup the telescope and carry out the polar alignment procedure. Then put the telescope in the Home Position (refer to Session 1 / Computerized telescope / Vixen SXD Mount, part A and B);
3 Carry out the two-star alignment procedure (refer to Session 1 / Computerized telescope / Vixen SXD Mount, part C);

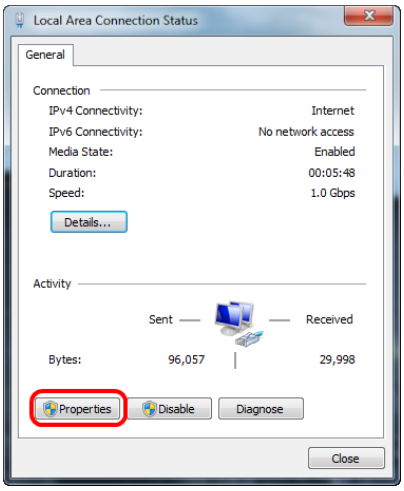
4 **Note:** After the above steps, do not manually move the telescope or the mount;

5 Before you can control the Star Book with your PC, the two must be linked with a LAN cable and find each other in the same network;

6 Link the Star Book and the PC with a **Crossover** type LAN cable;

7 After Windows has started, go to *Start* → *Control Panel* → *Network and Sharing Centre*. Click on *Local Area Connection* and then click Properties;

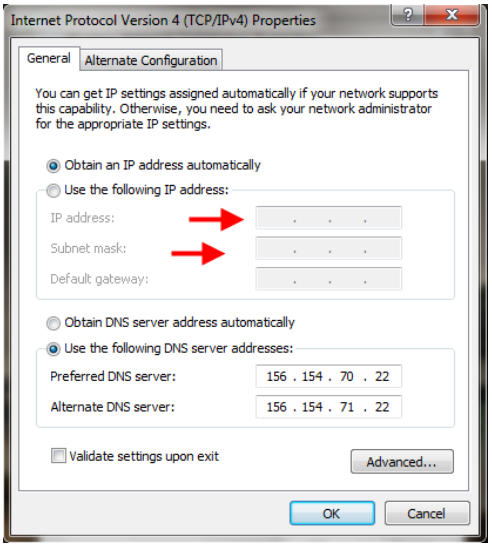




8 Select *Internet Protocol Version 4 (TCP/IPv4)* and click Properties;

9 From the Star Book menu About Star Book find the Star Book IP Address. It is usually169.254.a.b（a／b are random numbers);

10 Now in your computer dialogue box enter the following for IP address:
169.254.c.d (c, d are random numbers);



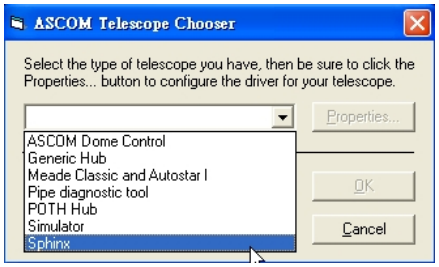
11 Enter the Subnet mask: 255.255.0.0;

12 Click OK on all screens and leave *Local Area Connection*;

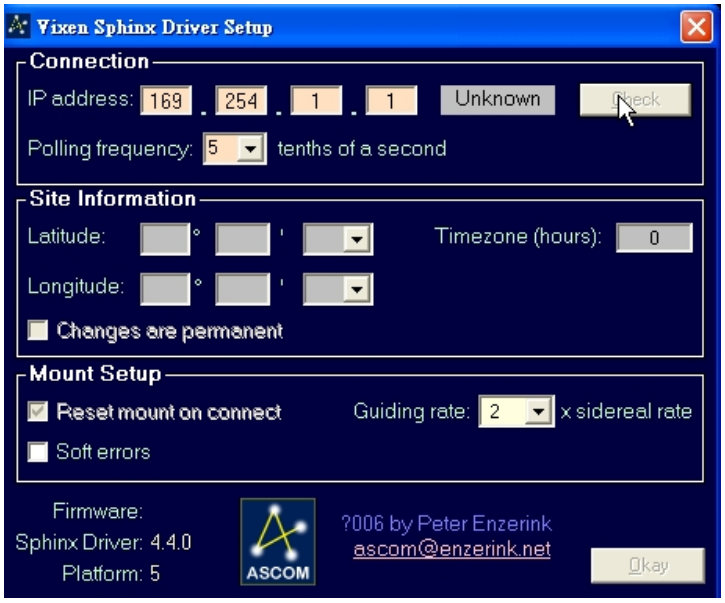
13 Wait a short while for Star Book and the PC to build a connection. Then open Hallo Northern Sky (or any other planetarium software), and make sure it is synchronized with the system time;

14 Star Book can also be controlled with Cartes du Ciel (refer to Part C below);

15 Press Control-8 to bring out the *ASCOM Telescope Chooser* box. Select Sphinx which is the Vixen Star Book series name;



16 Then click Properties to continue the configuration;



17 The IP address can be found from Star Book menu About Star Book. Enter accordingly and click Check. If everything is alright, the entry boxes will turn green;

18 Enter the coordinates and time zone of your observing site;

19 Press Okay to leave;

20 Now the software should be able to communicate with the telescope;

21 You should be able to see a small tool box bar on the top left;

22 Make sure The sky shown within the yellow circle is your current sky. If not use the Up/Down arrow keys on your keyboard to do the adjustment. To make it simple, the sun should not appear in the sky if it is night time;

23 Make sure the Track box in the Scope Simulator (Program Files --> Common Files --> ASCOM --> Telescope --> POTH) is checked. If not, click Setup to configure;

24 Point your cursor to any star above the horizon and left click. The telescope will drive to the selected target;

25 You can also press Control-M and input a celestial coordinate. Then click OK to issue a goto command;

26 Or in Search dialogue box enter an astronomical object and press GOTO to slew the telescope.

C Controlling with Meade Autostar

1 **Note:** If your are still using the old LX200 mount, download the LX200 driver from the Cart du Ciel web page instead of the ASCOM page;

2 **Note:** Most new computers do not come with a serial port socket. You have to buy a USB－RS232 conversion cable to connect the mount to the computer. The package should come with a driver disk;

3 Set up the telescope and align the scope properly. Then swing the telescope into their Park Position. Different mount models may have different Park/Home Positions. Consult your manual;

4 Make sure the telescope is powered off;

5 Connect the Autostar control box to the computer using the conversion cable.

6 Switch on the power;

7 Check which com port is assigned to the USB－RS232 adapter;

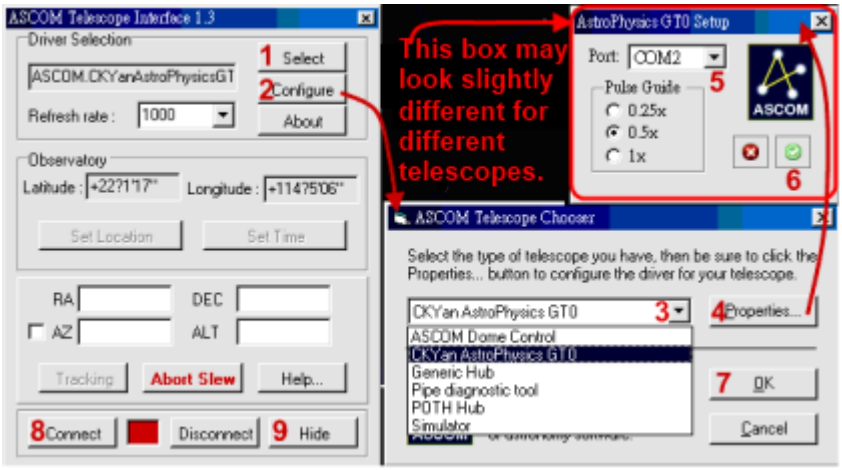
8 Fine tune the alignment. (refer to Session 1 / Computerized telescope / Meade telescopes with Autostar, part A and C);

9 **Note:** After the above steps, do not manually move the telescope or the mount;

10 Open the Cart du Ciel (Sky Chart) software;

11 From the top menu bar select : *Telescope* → *Control Panel* → *Select* ;

12 Select your telescope type. Then click on *Properties* to configure the telescope;



You have to finish Step 7 in the above picture before you can go to Steps 8 and 9.

13 In the Comm Setting click select the com port assigned to the USB－RS232 by the computer:

Baud Rate	9600
Data Bits	8
Parity	None
Stop Bit	1
Flow Control	None

14 Press Connect . If successful, the red boxes will turn green. You can also connect your telescope from the menu bar;

15 Now you can use the GoTo functions;

16 Just right click on a star that is above the horizon. Then choose Goto Cursor Position , and the telescope will slew to the selected star;

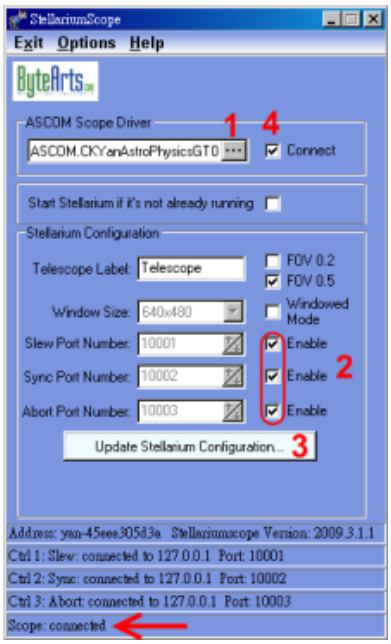
17 You can also use the *Search* → *Find* function to pinpoint any celestial object and then send your command to the telescope as in Step 16;

D Stellarium as a controlling software

1 Stellarium 0.10.4 comes with its own telescope control plugin. But this plugin has a limited telescope list and provides only the 'slew' command. There is no 'syn' or 'stop' command. So if you notice that the telescope is going to collide with some structure while slewing there's nothing you can do but

switch off the power of the telescope. This section introduces a third party software, StellariumScope v. 2010-04-11 (beta) which is only compatible with Stellarium 0.10.4 and is installed as a plugin;

2 Download StellariumScope v.2010-04-11 here:
http://www.welshdragoncomputing.ca/d/dgtocc/st/Setup_StellariumScope_20100411.exe
You must run Stellarium at least once before installing StellariumScope. After installation, run the programme and ignore any error message. Begin your configuration as Steps 1~3 in the picture below;



3 Click Update Stellarium Configuration and close StellariumScope. Also close Stellarium if it is launched;

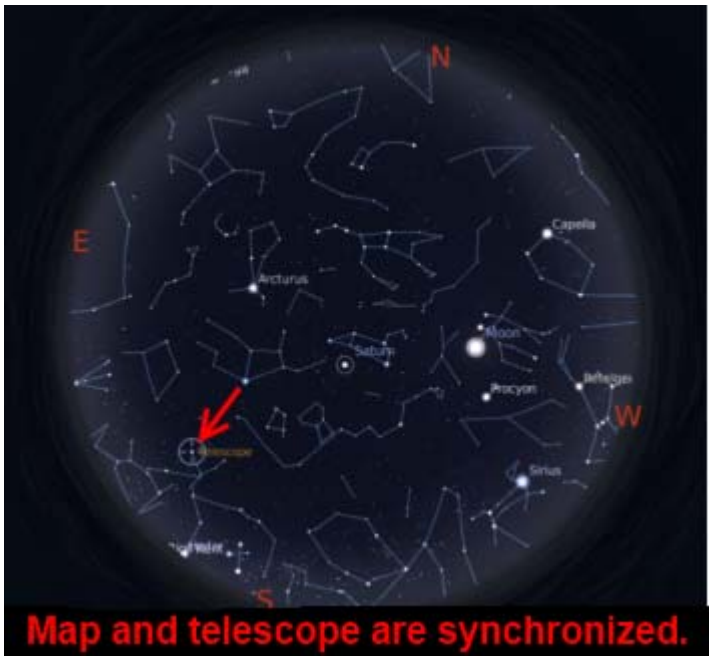
4 Connect the telescope to the PC and switch on the telescope;

5 Launch Stellarium;

6 Launch StellariumScope. Click on Connect. Wait a while and you should see Scope: connected at the bottom of the software window;

7 Point your telescope to a bright star and centre it in the eyepiece. Select the same star with your cursor in Stellarium;

8 Press Ctrl-2 (i.e. Press and hold Ctrl and press 2) to synchronize the telescope with the computer;



9 Click on another object in Stellarium and press Ctrl-1. This will issue a GoTo command. The telescope should start slewing to the new target;

10 If you want to stop the slewing for some reason, press Ctrl-3;

11 The Stellarium0.10.4comes with its own telescope control plug-in too. But remember, as said before, this plugin can only issue the 'Slew' command. There is no 'Stop' command for the time being;

12 Launch Stellarium0.10.4 and click on the Configuration icon. Click select Plugins . Select Telescope Control and check load at Startup;

13 Close and relaunch Stellarium. The icon should appear in the Display Bar. Click to select;

14 Add your telescope and carry out the configuration;

15 You can visit http://www.stellarium.org/wiki/index.php/Telescope_Control to find out more about telescope control with Stellarium.

E A GoTo Moon Atlas

1 Download the Virtual Moon Atlas Pro ver. 5:

http://sourceforge.net/projects/virtualmoon/files/1-%20virtualmoon/Version%205.0/Windows/vmapro5.exe/download

2 Set up and align the telescope as described in the Section C or D of this Chapter;

3 Issue a command to slew the telescope to point at the moon with your planetarium software or do it manually;

4 Launch Virtual Moon Atlasand carry out the necessary configurations, such as observing site and time;

5 Click to select the Tools menu. In Telescope select your telescope type;

6 Click Show Menu and proceed with the configuration;

7 With the telescope control box, point the telescope to an easily recognized feature on the moon. Centre it in the eyepiece. Then click on the same feature on the map with your cursor;

8 Click on Sync selected to synchronize the scope with the map;

9 Check Track position;

10 Now you can select any feature on the map and then press Goto selected to slew the telescope to the target;

11 You can also select your targets from within the Database.

F Suggested Activity

1 This activity can be considered as an extension to the Chapter activity in Session 1;

2 The teacher can organize an SGT manipulation contest;

3 Divide the students into groups. Students have to plan an object list for observation for a specified period of time that evening. The list should contain an even among of deep-sky objects which should spread out more or less evenly in the observable sky;

4 Students have to plan the fastest way to complete their observation;

5 A judge should be assigned to verify each object found;

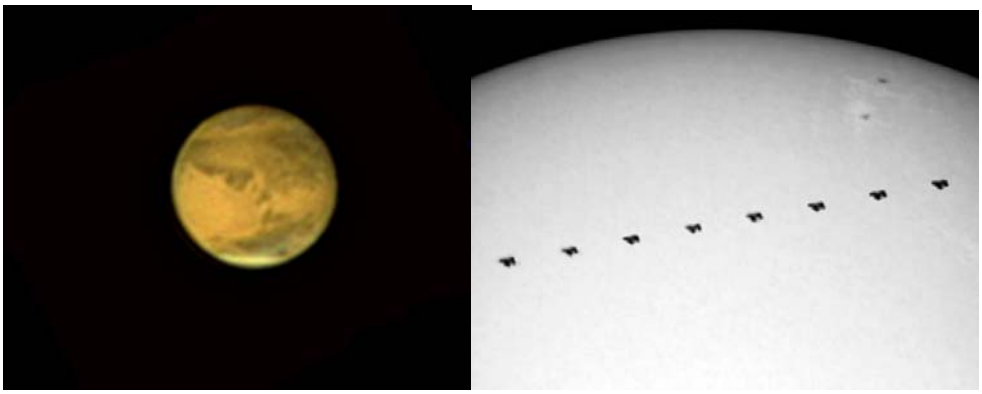
6 The teacher should assess on the students' attitude, skills, etc.

2 Astrophotography with a web cam

Astrophotography is a means of getting raw astronomical research results. This section should enable participants to manage the skill of astrophotography and be able to set up equipment for such activities.

Web cams have very small sensors built into them. They record images in video mode and are quite different from present-day DSLR cameras. Both of these types of cameras have their own merits and short comings and are used for different purposes.

Web cams are most suitable for taking pictures of planets, close-ups of sunspots and lunar features. Special softwares can be used to select and stack good picture frames from a video footage to produce a high quality image. Since web cams record in video mode, they are especially useful in capturing and timing transits and occultations too. Normal web cams are cheap but require some kind of adaptation before they can be fitted to telescopes.



Mars (left) and ISS passing in front of the sun (right). Both captured with a Philips web cam. ©Yan Chi Keung

Objectivies

1 The participant is able to prepare and set up a web cam for an astrophotography session;

2 The participant is able to prepare and set up a DSLR camera for an astrophotography session.

A Tools

1 An astronomical telescope (preferably on an equatorial mount) with tracking ability;

2 A web cam with a suitable telescope adaptor;

3 A lap-top computer.

B Setting up a web cam for astrophotography (using Philips ToUCam Pro / Philips *SPC900NC* as an example)

1 Install the Philips software. Do not connect the web cam to the computer yet.
(Download the 'Philips ToUcam Camera' software here if you have lost the installation disc)
http://download.p4c.philips.com/files/p/pcvc840k_00/pcvc840k_00_dxp_eng.exe

2 During installation, you will be prompted to plug the camera into the computer USB port. Do so as required;

3 If the computer successfully detects the camera, you should be able to see the video output in a small screen. Continue the configuration as instructed;

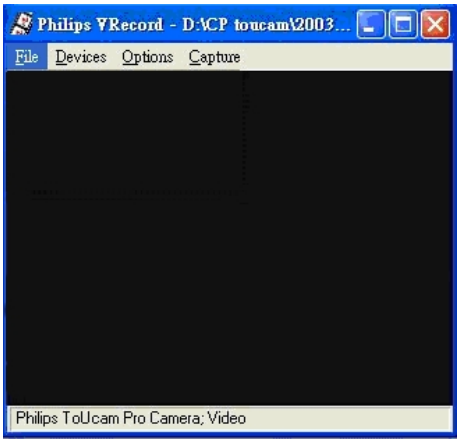
4 After the configuration the *Philips Vlounge* icon will appear on the desktop. This is not required for our purpose. You may delete it if you like;

5 Exit the software;

6 Open the *File Manager* and navigate to *Program Files* → *Philips ToUcam Camera*;

7 Look for the "Philips VRecord" file and right-click on it. Then scroll to *Send to* → *Desk top as Shortcut* and click to confirm;

8 Double-click "Philips VRecord" to open the video record box;



9 The initial setup has been successful.

C Taking planetary/lunar pictures (the following procedures are also applicable for other web cams)

1 Video photography is advantageous to taking planetary images;

2 Setup your telescope and attach the web cam to it;

The Philips ToUCam Pro (left) and the Philips SPC900NC (right) with adaptors attached.

3 Power on your computer;

4 Connect the web cam to the computer;

5 Start '*Philips VRecord*';

6 Click select File → Set Capture File. Enter a file name. It is best to use a date_time_serial number format file name (e.g. 20100530_213000_01) for easier file management later;

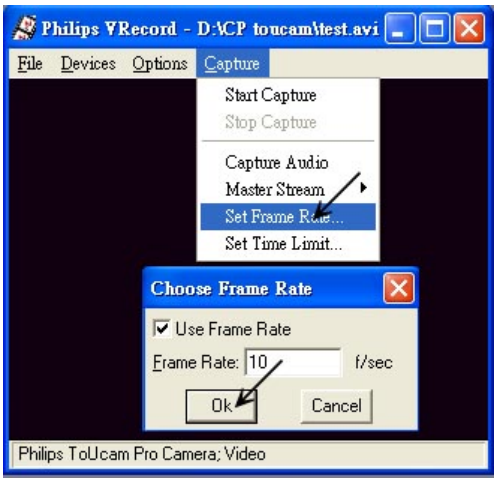
7 To make sure the file is saved, and would not overwrite a previous recording, make it a habit to click select File → Save Captured Video As to save the file after each recording;

8 Click select Options → Video Format. Select the '640 x 480' format so you can record in the highest resolution. Other formats with smaller frame sizes have lower resolution and are not recommended. But sometimes these formats may be useful for recording faint objects;

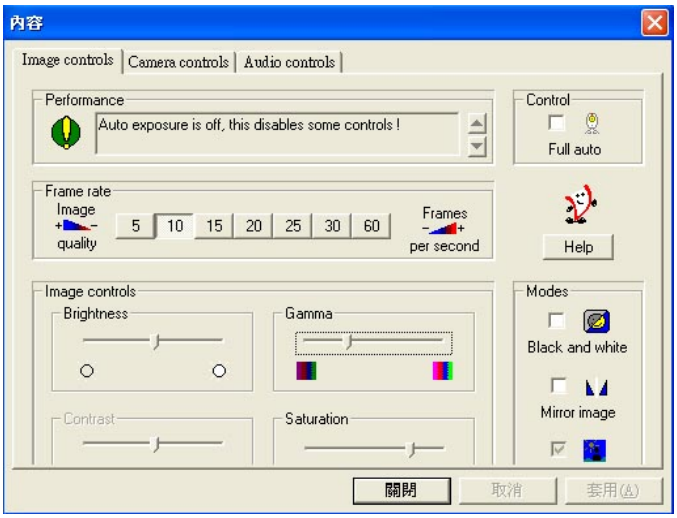
9 Click select Capture → Capture Audio and make sure the sound recording function is disabled;

10 Centre the image in the preview screen and focus. A motor-driven focuser makes the job easier;

11 Click select Capture → Set Frame Rate dialogue box. Select 5 to 15 f/sec frame rate. A faster frame rate will produce higher noise;



12 Click select Options → Video Properties. Then choose Image controls;



13 Configure as follows:

a Frame rate: 5 or 10 frame rate is recommended;

b Control: Uncheck '*Full auto*';

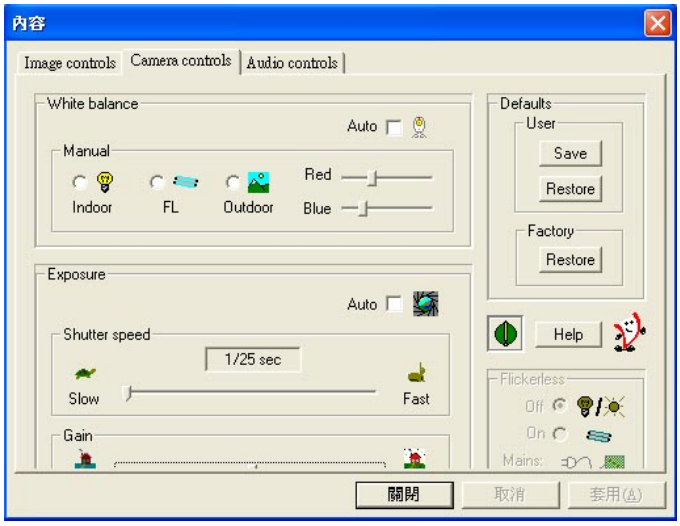
c Brightness: Set as default (50) for the time being;

d Gamma: Sliding to the left will give higher contrast. When atmospheric transparency is poor this could give you better results;

e Saturation: Set this somewhere between 60 and 90. When atmospheric transparency is high slide more to the right;

f Modes: Stay in colour mode. But the B/W mode is useful when recording the moon or the sun.

14 Click selct Options → Video Properties → Camera controls;

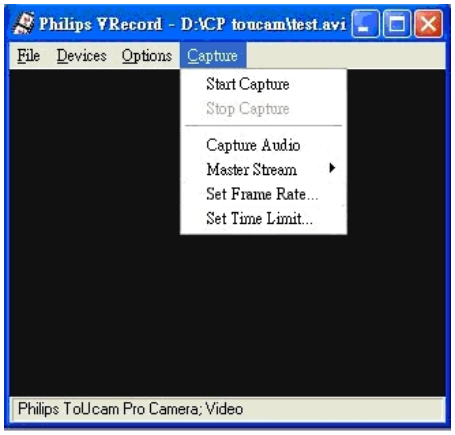


15 Configure as follows:

a White balance: Click to select Auto first and let the camera do some adjustment. When you are sure the colour looks natural uncheck it;

b Exposure and Gain: Slide Shutter speed lever. Pay attention to the bright and dark regions and decide for yourself. If the image is too dim, increasing the Gain may help. But more graininess may result.

16 Before you start recording you should select Set Time Limit to set the length of your video. You can also press Esc to end the recording;



17 When everything is ready, click select Capture → Start Capture . Click OK when you are ready. Remember to add a serial number to the end of your file name each time you've done a recording and save it;

18 For post processing, read Chapter 4.

D Suggested Activities

1 There are suggestions found in the EDB Science Education Section's Physics World web page. Activities include measuring the moon's diameter, measuring the size of the umbra and the distance to the moon during a lunar eclipse. You can download the file here: http://www.hk-phy.org/astro/tcs.zip ;

2 To calculate the speed of light by means of recording the satellite events of Jupiter. You can download the necessary software and description here:

http://public.gettysburg.edu/~marschal/clea/CLEAhome.html;

3 Measure the height of lunar mountains:
http://www.tass-survey.org/classes/phys236/moon_mount/moon_mount.html
http://www3.gettysburg.edu/~marschal/clea/lunarlab.html

3 Astrophotography with a DSLR

A DSLR has a larger sensor than an ordinary web cam and is therefore suitable for wide field photography.

A Tools

1 An astronomical telescope (preferably on an equatorial mount) with tracking ability;
2 An optional second telescope, with reticle illumination eyepiece, for guiding purpose;
3 A fully charged DSLR with an optional charged backup battery;
4 Camera lenses that suit your purpose;
5 A camera shutter release for your camera type. Always use a shutter release to minimize vibration;
6 A heavy duty tripod with tripod head;
7 A camera adaptor with T-ring (M42 ring) for mounting your camera to the telescope;
8 A fully charged laptop with a long USB cable for connecting to the camera;
9 Other options include: a barlow lens, a wide-field converter lens, eyepieces, chairs and tables, etc.

B No-tracking photography (constellations, star trails, meteors, artificial satellite tracks)

1 Equipment: A DSLR with a standard to wide lens, a tripod, a shutter release, a camera viewfinder magnifier, a stop watch;
2 Screw the camera onto the tripod;
3 Attach all accessories (saving the image to the memory card is faster than saving to the computer);
4 Decide the best zoom ratio for your final target if you are using a zoom lens. Aim at the brightest object in the sky (moon, planet or star) and focus manually. You may find the viewfinder magnifier helpful but a camera with live-view mode is even better;
5 Switch the camera to manual mode and use the maximum lens aperture;
6 Select the highest ISO with acceptable noise. It is good to begin testing with 800, 1000, 1600 to find the best compromise;
7 Centre the focused object and begin a series of exposures, starting with 5 seconds, 10 seconds.., etc.(the moon requires much faster shutter speed). Find the exposure that gives an image that is clear and not over exposed;
8 After you have found the exposure, begin fine-tuning your focus. Turn the focus ring a very minute among and expose. Magnify it and compare the image with the one you took in step 7. If the second image is sharper, turn the focusing ring in the same direction further little bit and snap another shot. If the second image is not as sharp, turn the ring the other way and shoot. Compare and shoot until you get the sharpest focus;
9 Use blu-tack to fix the zoom ring and the focus ring;
10 Now turn the camera and aim it at your target constellation. Choose an exposure of 15 seconds and trigger the shutter release;
11 Usually a wide open camera lens has lower resolution because of lens design. You can experiment taking pictures with stop down aperture. Find the best compromise between bright and sharp star points;

12 When taking pictures of constellations, begin with a 15-second exposure and then a 5-second increment for the next. Your maximum exposure may be as long as 30 seconds, depending on the celestial region and the lens;

13 You may lengthen the exposure for the polar region and vise versa for the equatorial region. You have to take into account the light pollution factor of your site too.

14 For taking pictures of star trails or meteors you have to expose for over an hour. Turn the exposure dial to 'bulb' and use a stop watch for count down. Some shutter releases have this function built-in;

15 Choose a smaller aperture for long exposures. Experiment with f/5.6, f/8 and f/11 to find the best result;

C Tracked photography (constellations, star fields, meteor showers)

1 Equipment: A telescope with tracking ability, a DSLR with a standard to wide angle lens, a tripod head, a shutter release, a camera viewfinder magnifier, a stop watch;

2 Attach the tripod head onto the telescope and screw the camera onto it;

3 Attach all accessories;

4 Depending on the target subject, you have to choose between a wide-angle lens and a telephoto lens. A wide angle lens is suited for imaging constellations and meteor showers. A telephoto lens may be used for photographing deep-sky star field / large deep-sky objects;

5 Aim at the brightest object in the sky (moon, planet or star) and focus manually;

6 Operate the camera manually. Select the best lens aperture (Steps: B5-7). If you are using a telephoto lens, you can set to a larger aperture;

7 Refer to Steps B8-9 for focusing;

8 Point the telescope to a bright star near your camera target. This will be your guide star. Centre the star in the eyepiece;

9 The eyepiece for tracking should be equipped with an illuminated reticle;

10 Defocus the star image a bit so it becomes a white disc with the cross hair in the centre;

11 Try moving the star disc around with your control. Track the star for a minute or two before start taking the picture;

12 For photographing constellations, begin your test with a 2-minute exposure. Increase or decrease the exposure subsequently to find the best result;

13 For photographing deep-sky objects, begin your test with a 5-minute exposure. Increase the exposure subsequently to find the best result;

14 For photographing meteor showers, begin your test with a 15-minute exposure. Increase the exposure subsequently to find the best result;

15 Go to this web site for an experience of guiding a virtual telescope: http://www.petesastrophotography.com/guidingsim.html

D Close-up photography with the telescope as your camera lens (lunar features, sunspots and eclipses)

1 Equipment: A telescope with tracking functions, a DSLR camera body, a shutter release, a camera viewfinder magnifier, a stop watch, a camera adaptor, a barlow / wide-angle converter lens and a solar filter;
2 Attach the camera to the back of the telescope using an adaptor;
3 Depending on your subject, you may be using a barlow / converter lens or an eyepiece;
4 **It is important to put on a solar filter before you can look at or photographing the sun;**
5 Setup the telescope and start tracking;
6 When you are photographing the sun, it would be helpful to align the sun's E /W motion with one side of the viewfinder rim;
7 Choose the best power to fit your target inside the viewfinder;
8 Focus as describe in Steps B8-9;
9 The sun and moon are bright objects. Switch the camera to auto mode. Use the suggested exposure as a starting point. Then switch back to manual mode and begin your exposure test;
10 Snap a few shots for each exposure. You can then choose the best after you have downloaded the images into your hard drive.

E Close-up photography with the telescope as your camera lens (deep-sky objects)

1 DSLRs are a good choice for taking pictures of deep-sky objects;
2 Equipment: A telescope with tracking ability, a DSLR camera body, a tripod head, a shutter release, a camera adaptor, a barlow / wide-angle converter lens, a camera viewfinder magnifier, a stop watch;
3 Attach the camera to the back of the telescope using an adaptor. Depending on the subject, decide on whether to use a barlow / wide-angle converter lens or not;
4 Point the telescope to a bright stellar object, preferably a planet (since you are photographing deep-sky objects, the moon would not be in the sky);
5 Focus as describe in Steps B8-9. Then find a guide star as Steps C8-10;
6 Issue a 'GoTo' command to point the telescope at your target. Adjust your camera frame;
7 Dial to 'bulb' and select the best high ISO. Start your exposure;
8 Try different exposures. Begin with 1 minute, 2 minutes, 4 minute, 8 minutes...
9 All exposures can be used in the final processing to produce a good, dynamic picture.

4 Astrophotography: Image processing

For information only

Images taken by a DSLR or a web cam must be digitally processed in order to extract the finest details. Processing include the following procedures.

a Stacking: This procedure is mainly for videos taken with a web cam. The idea is to extract the best frames and merge them into one single good image. Multiple images taken with a DSLR can also use this process to improve picture quality;

b Information extraction: This includes adjusting the brightness, saturation, contrast and applying an unsharp mask to visualize feeble features hidden in the image. These could be done with softwares such as *Photoshop* or the freeware *Gimp*;

c Mosaic: When photographing a large object such as the sun or the moon at high resolution, it is necessary to snap shots of different regions and later mosaic the images to make a complete picture.

During a long exposure, all CCD and CMOS will produce extra noise and dead / hot pixels will become noticeable. These can be significantly reduced through special processing techniques.

The freeware Registax is used to illustrate the processing procedure.

Software downloads:

Registax (for stacking web cam frames): http://www.astronomie.be/registax/

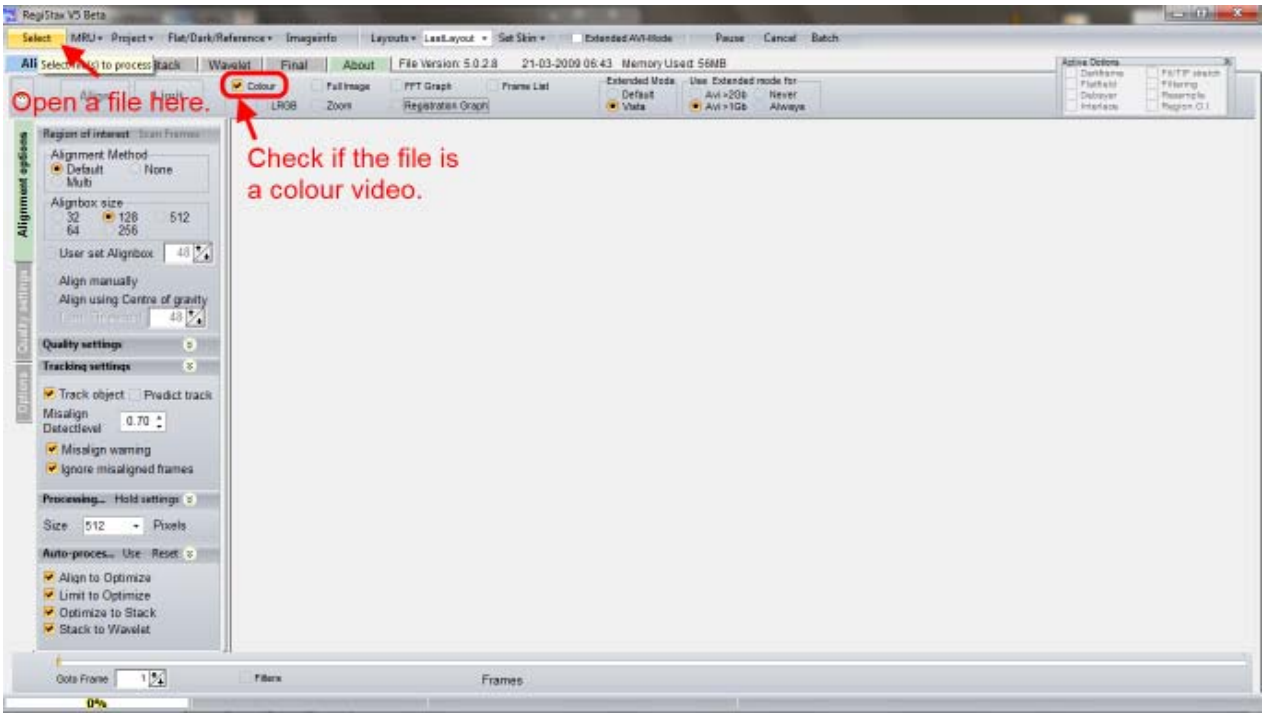
Gimp: http://www.gimp.org/

DeepSkyStacker (for stacking DSLR images):http://deepskystacker.free.fr/english/index.html

A Initial processing with Registax v.5

The following is a simple illustration. Refer to the manual for details.

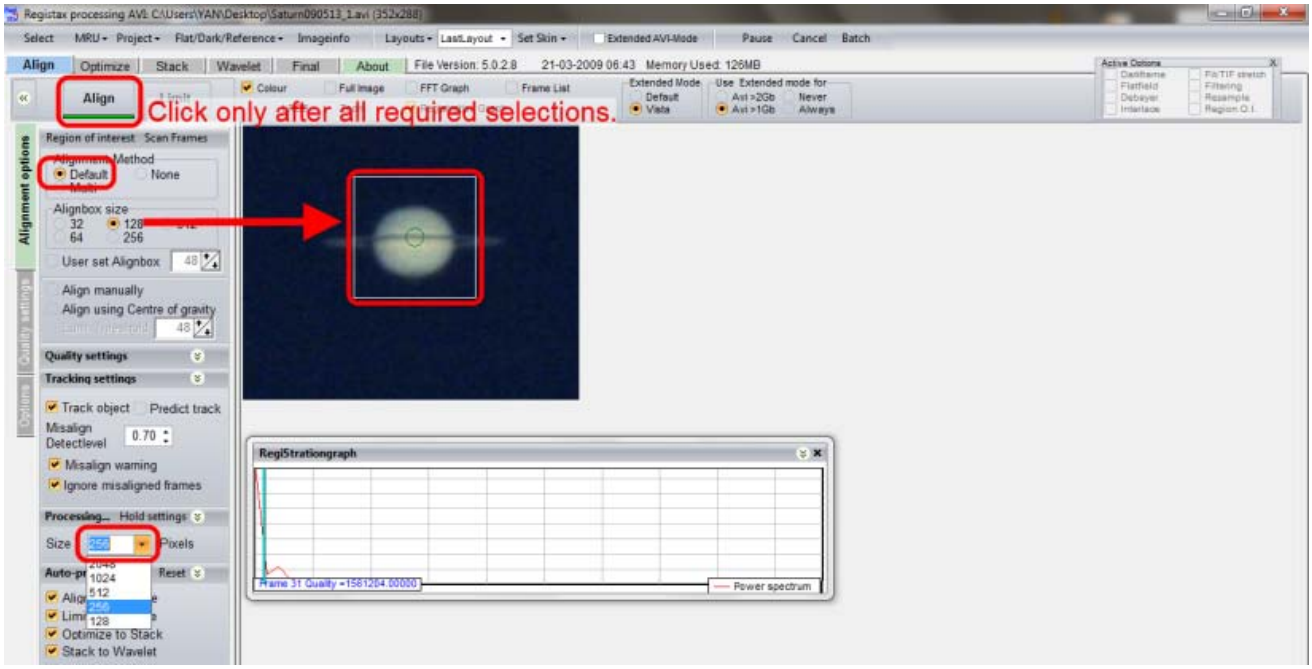
1 Start Registax v.5;



2 Click Select and select Open file to open a recorded avi format video file;

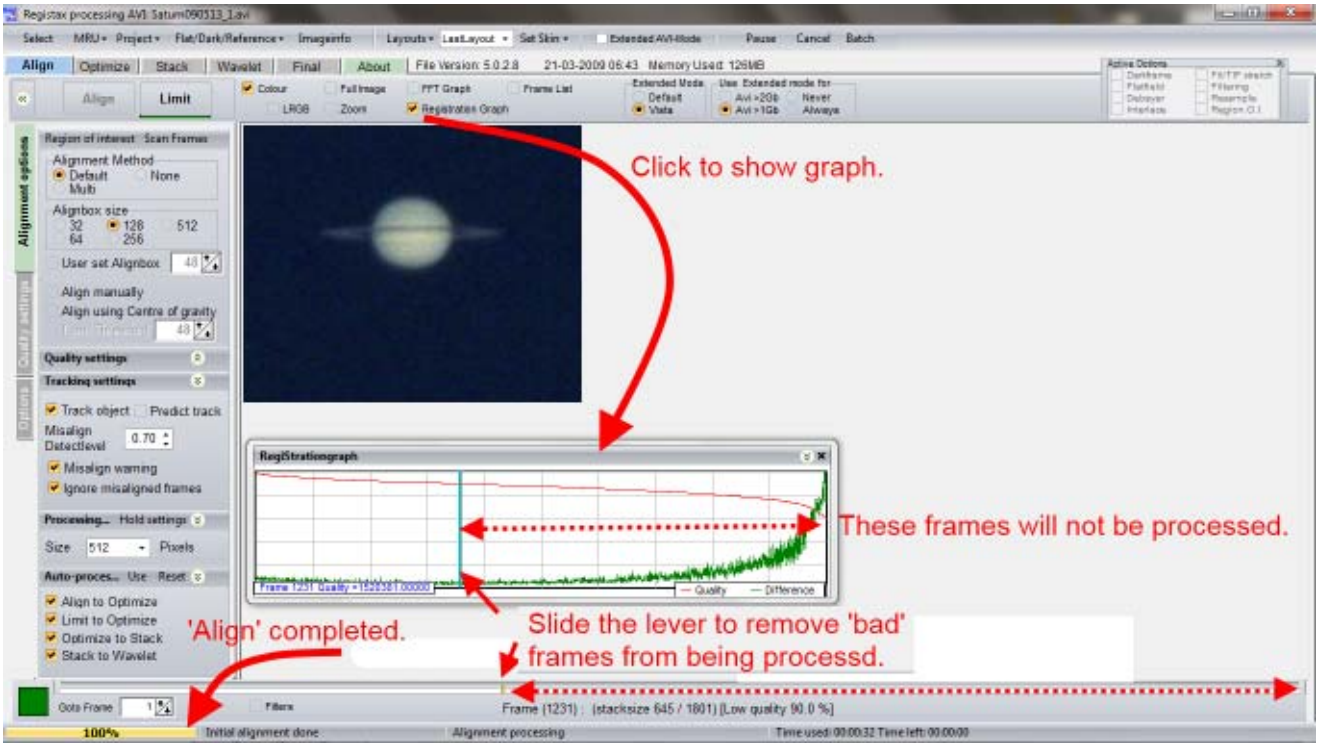
3 Slide the small. yellow lever at the bottom to choose a good frame from the beginning of the footage. It is more convenient to use the left and right arrows to scroll through the frames;

4 From *Alignment Method* select Default . Choose an *Alignment box* that just covers the whole planet. For moon closeups, use the largest box;

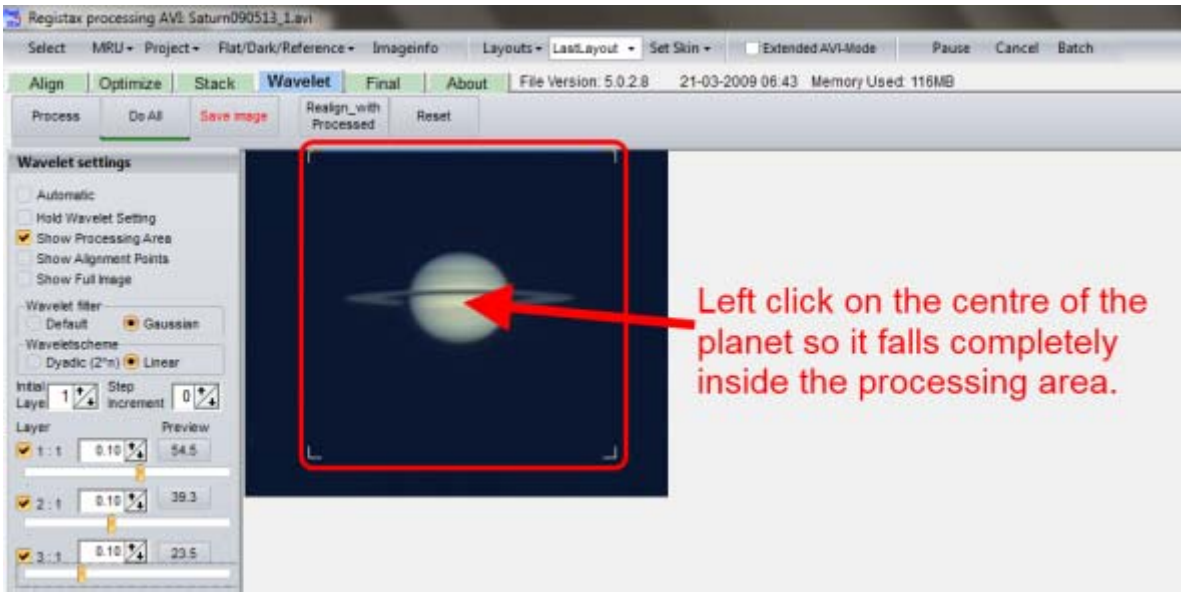


5 Press Align and the software will run through the video and rearrange the frames from the best to the worst. When the left-bottom yellow bar reads 100%, the process is finished. Click select *RegiStrationgraph* to show a quality graph chart of the frames;

6 In the RegiStrationgraph the sharpest frames are lined up from the left. With your cursor, slide the bottom lever so all the unwanted 'bad' frames are on the right of the blue verticle bar. Click Limit and the unchosen frames will not be processed;



7 Click Optimize and Stack and let Registax do the rest. After the process, the software will jump to the Wavelet page, check Show Processing Area to see if the alignment box contains the whole planet. If not, click on the centre of the planet. Adjust the slide levers under Wavelet settings to enhance the contrat and fine details. Normally it is not recommended to adjust more than 3 layers;



8 Click select Final → Save Image to save your processed image. Use a file name other than the original;

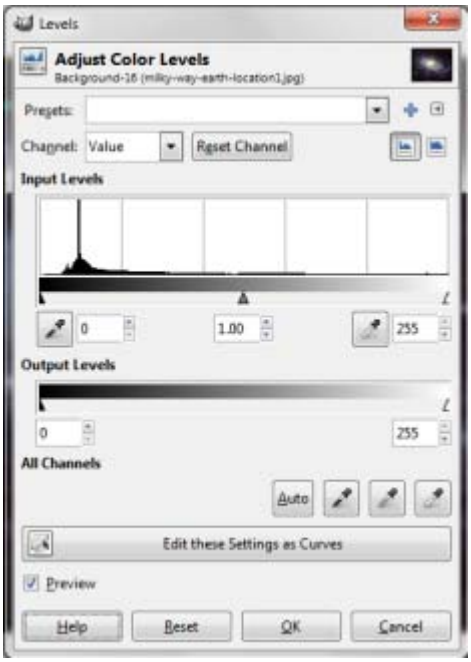
9 After you have become experienced, you can try more options.

B Post processing (with Gimp)

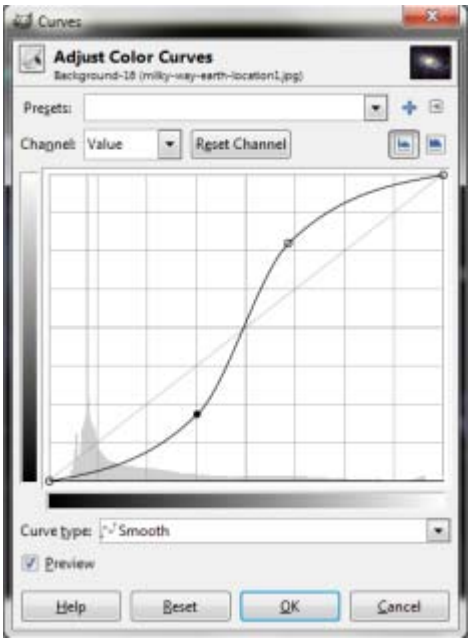
Images processed with Registax are quite satisfactory already. But further processing with Photoshop or Gimp makes the images more appealing. Always remember: over processing an image will make it too grainy and unnatural.

The following describes a simple routine of image processing. Different types of celestial images have different processing routines. It is recommended to select Preview while doing processing.

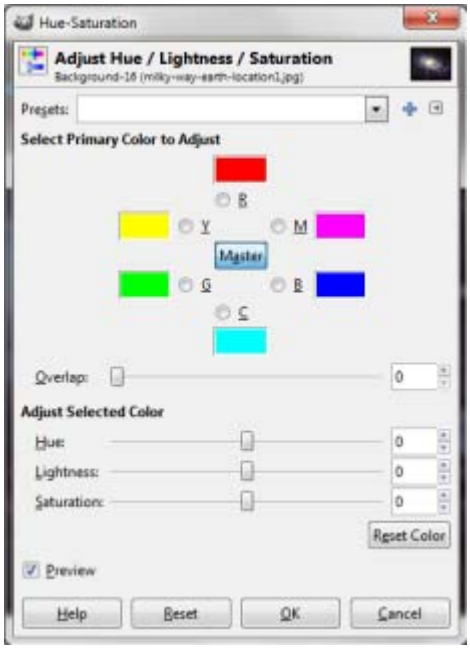
1 The most used tool is Colors → Level as in the picture below. This tool applies changes to the histogram of the photograph. Just load your image and try shifting the small triangles under the two bars and see the result. Adjustment of the individual primary colours are possible;



2 Another tool to adjust the exposure of an image can be called from Colors → Curves. You can point your cursor to any place on the diagonal line. Hold the left button and move to apply adjustment. You can select multiple points;



3 You can adjust the hue and colour saturation of the image through Colors → Hue-Saturation. You can adjust the hue, brightness and saturation of six colours. You can also do all the adjustments in one single step;



4 You can enhance the details using a tool known as an unsharp mask. This tool can be called from Filters → Enhance. Try adjusting the Radius and the Amount to see the difference.

C Noise reduction

Vignetting, dead / hot pixels, noise grains can all be drastically removed to make an image look sharp and clean. This is done through a digital stacking process. For the DSLR this requires extra exposures known as dark frames and flat fields. For the web cam, there is practically no pixel problem. Web cam images are highly magnified. Because of air current and minor tracking errors, the planet image does not stick to the same pixels throughout the recording. It shifts around. During the stacking process the hot /dead pixels and noise grains will be cancelled out.

1 *Dark frames:* Consumer grade CCDs are not perfectly made. Dead pixels will show up in the image as red or blue dots. They may be mistaken as stellar images. During a long exposure, the DSLR CCD warms up and electrons are created. These electrons are captured by the CCD and recorded as 'signals'. All these can be removed using 'dark frames'. As a rule, you need at least one dark frame of the same exposure for each normal image frame you take. The more the better. If you plan to stack 50 frames of M42, each exposed for 5 minutes, you need the same number of dark frames. That is not quite practical. Normally the photographer would just make 10 to 20 dark frames and get extremely good result. Dark frames should be taken right after the photographing session. Use the same ISO setting. Just put on the lens cap and time the exposure. Some electronic shutter release or software programme will do this for you automatically;

2 *Flat fields:* Vignetting is produced by the lens and not the CCD. To make flat fields, attach the camera to the lens or telescope you used to take pictures. Use the same ISO setting. Point the camera to any evenly lit scene (the blue sky is a good choice) and expose. You can use auto exposure. Apply the same number of flat fields as you do for the dark frames;

3 *Bias frames:* Other kinds of noise produced by the camera circuitry are read by the CCD during exposure. They can be reduced using bias frames. To make a bias just close the lens cap and expose at the shortest shutter speed your camera provides. Remember to use the same ISO setting. Wait for at

least 30 seconds for the camera circuitry to return to normal temperature before the next exposure;

4 Load the normal frames (light frames), dark frames, flat fields and bias into DeepSkyStacker. Everything is done automatically.

5 Magazines and web resources

Observation	
1	**Inconstant Moon** http://www.inconstantmoon.com/
2	**NASA Eclipse Web Site** http://eclipse.gsfc.nasa.gov/eclipse.html
3	**Sky Tour** http://skytour.homestead.com/files/skytour.html
4	**Astronomy with a 60 mm refractor** http://astrosurf.com/l60/en/index_en.html
5	**Deep sky database** http://www.virtualcolony.com/sac/
6	**Heavens above satellite predictions** http://www.heavens-above.com/
7	**Deep sky objects** http://messier45.com/
8	**Moon calendar** http://paulcarlisle.net/mooncalendar/
9	**Sky Calendar** http://www.skycalendar.com/skycal/index.html
Education	
1	**Kids astronomy** http://www.kidsastronomy.com/
2	**The Astronomy Net** http://www.astronomy.net/
3	**Astronomy Today** http://www.astronomytoday.com/
4	**Bad Astronomy** http://blogs.discovermagazine.com/badastronomy/
5	**Constellations: Stories and a Deepsky Atlas** http://www.hawastsoc.org/deepsky/
6	**Nick Strobel's Astronomy Lecture Notes** http://www.astronomynotes.com/
7	**The Eight Planets** http://www.nineplanets.org/
8	**Contemporary Laboratory Exercises in Astronomy** http://www3.gettysburg.edu/~marschal/clea/CLEAbase.html
Star maps	
1	**Interactive Sky Chart**

	http://www.skyandtelescope.com/observing/skychart/
2	**Download free monthly sky maps** http://www.skymaps.com/
Star maps in your mobile	
1	**Mobile Planetarium for Java-Enabled Mobile Phone** http://mobilestarchart.sourceforge.net/
2	**Sideralis (Windows mobile)** http://sideralis.free.fr/
Astronomical pictures	
1	**Hubble Site** http://hubblesite.org/gallery/
2	**Mauna Kea and Haleakala Images** http://www.ifa.hawaii.edu/images/
3	**Planetary Images from NASA** http://photojournal.jpl.nasa.gov/index.html
4	**Astronomy Picture of the Day** http://antwrp.gsfc.nasa.gov/apod/astropix.html
5	**The Messier Catalog** http://www.seds.org/messier/
6	**The Solar & Heliospheric Observatory** http://sohowww.nascom.nasa.gov/
Astronomical softwares	
1	**Astronomy freeware for downloading** http://www.dewshields.com/programs.html
2	**AstroTips** http://astrotips.com/
3	**ASCOM drivers for telescope mounts** http://ascom-standards.org/Downloads/ScopeDrivers.htm
Forums	
1	**Hong Kong Astronomical Society Forum 香港天文學會討論區** http://forum.hkas.org.hk/
2	**HKAS Occultation Forum 香港天文學會-掩星組** http://occultation.freebbs.hk/index.php
3	**牧夫天文論壇**（中國） http://www.astronomy.com.cn/bbs/index.php
4	**Hong Kong Astro Forum 天文論壇** http://www.hkastroforum.net/
Local astronomical societies	

1	**Hong Kong Astronomical Society 香港天文學會** http://www.hkas.org.hk/
2	**Sky Observers' Association (H.K.) 坐井會** http://www.skyobserver.org/
3	**Space Observers H.K. 香港觀天會** http://www.sohk.org.hk/
4	**Starrix 星滙點** http://www.starrix.org/
Magazines	
1	**Amateur Astronomy Magazine** http://www.amateurastronomy.com/
2	**Astronomy Education Review** http://aer.noao.edu/cgi-bin/new.pl
3	**Astronomy Now** http://www.astronomynow.com/
4	**Icarus (American Astronomical Society)** http://icarus.cornell.edu/
5	**Journal of the British Astronomical Association** http://britastro.org/baa/content/view/75/110/
6	**Journal of The Astronomical Society of the Pacific** http://www.astrosociety.org/pubs/mercury/mercury.html
7	**Sky and Telescope** http://www.skyandtelescope.com/
8	**The Universe in the Classroom** http://www.astrosociety.org/education/publications/tnl/tnl.html
9	**The Astronomer Online** http://www.theastronomer.org/
10	**Amateur Astronomer (天文愛好者)** http://www.bjp.org.cn/aa1/
11	**Chinese National Astronomy (中國國家天文)** http://www.cnastro.cn/

6 A list of bright stars

	Star (English)	Star (Chinese)	Star (Astronomical)	Constellation	Magnitude
1	Acamar	天 園 六	q Eri	波江	2.91
2	Achernar	水委一	α Eri	波江	0.5
3	Acrux	十字架二	α 1 Cru	南十字	1.4
4	Adara	弧矢七	ε CMa	大犬	1.51
5	Al Na'ir/Alnair	鶴一	α Gru	天鶴	1.74
6	Albireo	輦道增七	β Cyg	天鵝	3.1
7	Alcor	開陽增一	80 UMa	大熊	4
8	Alcyone	昴宿六	η Tau	金牛	2.85
9	Aldebaran	畢宿五	α Tau	金牛	0.85 var
10	Alderamin	天鉤五	α Cep	仙王	2.44
11	Algenib	壁宿一	g Peg	飛馬	2.83
12	Algieba	軒轅十二	g Leo	獅子	1.9
13	Algol	大陵五	β Per	英仙	2.12 var
14	Alhena	井宿三	γ Gem	雙子	1.9
15	Alioth	玉衡（北斗五）	ε UMa	大熊	1.76
16	Alkaid	搖光（北斗七）	η UMa	大熊	1.85
17	Almach/Almaak	天大將軍一	γ 1 And	仙女	2.26
18	Alnath	五車五	b Tau	金牛	1.65
19	Alnilam	參宿二	ε Ori	獵戶	1.7
20	Alnitak	參宿一	x Ori	獵戶	1.76
21	Alphard	星宿一	α Hya	長蛇	2
22	Alphekka	貫索四	α 1 CrB	北冕	2.24
23	Alpheratz	壁宿二	α And	仙女	2.06
24	Alschain	河鼓一	b Aql	天鷹	3.7
25	Altair	牛郎(河鼓二)	α Aql	天鷹	0.77
26	Ankaa	火鳥六	α Phe	鳳凰	2.37
27	Antares	心宿二	α Sco	天蝎	1.09
28	Arcturus	大角星	α Boo	牧夫	−0.04 var
29	Arneb	廁一	a Lep	天兔	2.58
30	Bellatrix	參宿五	γ Ori	獵戶	1.64
31	Betelgeuse	參宿四	α Ori	獵戶	0.58 var
32	Bogardus	五車四	θ AUR	御夫	2.6
33	Canopus	老人星	α Car	船底	−0.72
34	Capella	五車二	α 1 Aur	御夫	0.71

35	Caph	王良一	β Cas	仙后	2.27
36	Castor	北河二-A	α1 Gem	雙子	1.96
37	Cor Caroli	常陳一	a CVn	獵犬	2.9
38	Deneb	天津四	α Cyg	天鵝	1.25
39	Denebola	五帝座一	β Leo	獅子	2.14
40	Diphda	土司空	β Cet	鯨魚	2.04
41	Dubhe	天樞（北斗一）	α1 UMa	大熊	1.87
42	El Nath	五車五	β Tau	金牛	1.68
43	Enif	危宿三	ε Peg	飛馬	2.4
44	Etamin	天棓四	γ Dra	天龍	2.23
45	Fomalhaut	北落師門	α PsA	南魚	1.16
46	Gacrux	十字架一	γ Cru	南十字	1.63
47	Gienah	天津九	ε Cyg	天鵝	2.5
48	Hadar (Agena)	馬腹一	β Cen	半人馬	0.6
49	Hamal	婁宿三	α Ari	白羊	2
50	Izar	梗河一	e Boo	牧夫	2.37
51	Kaus Australis	箕宿三	ε Sgr	人馬	1.8
52	Kochab/ Kocab	帝	β UMi	小熊	2.08
53	Markab	室宿一	α Peg	飛馬	2.49
54	Megrez / Megres	天權 (北斗四)	d Uma	大熊	3.4
55	Menkar	天囷一	a Cet	鯨魚	2.53
56	Menkent	庫樓三	θ Cen	半人馬	2.06
57	Merak	天璇（北斗二）	β UMa	大熊	2.35
58	Mimosa	十字架三	β Cru	南十字	1.3
59	Mintaka	參宿三	d Ori	獵戶	2.23
60	Mira	蒭藁增二	o Cet	鯨魚	2.1
61	Mirach	奎宿九	β And	仙女	2.06
62	Mirfak / Mirphak	天船三	α Per	英仙	1.82
63	Mizar	開陽-A	ζ1 UMa	大熊	2.27
64	Murzim	軍市一	β CMa	大犬	1.98
65	Navi	閣道二	e Cas	仙后	3.4
66	Nihal	廁二	b Lep	天兔	2.84
67	Nunki	斗宿四	σ Sgr	人馬	2.06
68	Peacock	孔雀十一	α Pav	孔雀	1.91
69	Phecda/ Phad	天璣（北斗三）	γ UMa	大熊	2.43
70	Polaris	北極星（勾陳一）	α UMi	小熊	2.01 var
71	Pollux	北河三	β Gem	雙子	1.15
72	Procyon	南河三	α CMi	小犬	0.34

73	Ras Alhague	候	α Oph	蛇夫	2.1
74	Rasalgethi	帝座	a Her	武仙	3.08
75	Regulus	軒轅十四	α Leo	獅子	1.35
76	Rigel	參宿七	β Ori	獵戶	0.112
77	Rigel Kentaurus	南門二	a Cen	半人馬	-0.27
78	Sadal Melik	危宿一	a Aqr	寶瓶	2.96
79	Sadr	天津一	γ Cyg	天鵝	2.24
80	Saiph	參宿六	k Ori	獵戶	2.06
81	Sargas	尾宿五	θ Sco	天蝎	1.86
82	Scheat	室宿二	β Peg	飛馬	2.42
83	Schedar / Shedir	王良四	α Cas	仙后	2.25
84	Shaula	尾宿八	λ Sco	天蝎	1.62
85	Sirius	天狼星	α CMa	大犬	−1.47
86	Spica	角宿一	α Vir	室女	1.04
87	Tarazed	河鼓三	g Aql	天鷹	2.72
88	Thuban	右樞，紫微右垣一	a Dra	天龍	3.7
89	Unukalhai	蜀，天市右垣七	a Ser	巨蛇	2.65
90	Vega	織女星	α Lyr	天琴	0.03
91	Vindemiatrix	東次將，太微左垣四	e Vir	室女	2.83
92	Wei	尾宿二	ε Sco	天蝎	2.29
93	Wezen	弧矢一	δ CMa	大犬	1.84